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Case Report

A rare anomaly of LAD mimicking CTO

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ABSTRACT

A 65-year-old man was admitted into our hospital because of the detailed examination for abnormal Q waves in inferior leads on an electrocardiogram. Coronary angiography and 320-row area detector computed tomography (ADCT) revealed "dual left anterior descending artery (LAD)", which was a rare anomaly of the LAD and chronic total occlusion (CTO) at segment 2 of the right coronary artery (RCA). The course of the anomalous LAD arising from the proximal portion of the RCA was specifically identified between aortic root and right ventricular outflow tract (RVOT) by 320-row ADCT. The anomalous LAD had potential risk of myocardial ischemia because of the compression from aortic root and RVOT during exercise. We performed technetium myocardial perfusion scintigram to evaluate exercise-induced ischemia in the territory of the anomalous LAD and to decide therapeutic strategies including coronary artery bypass grafting surgery to the vessel. The scintigram revealed no exercise-induced ischemia in anteroseptal wall and a constant perfusion defect in posteroinferior wall of the left ventricle. Thus, we decided to treat the patient with pharmacological treatment in the outpatient setting. This report suggests that it is important to recognize the variants of coronary arteries for optimal treatment.

<**Learning objective:** Coronary artery anomalies such as "dual left anterior descending artery" are particularly rare. Anomalous coronary artery may contribute to exercise-induced myocardial ischemia and sudden cardiac death by the compression of the great arteries even when coronary angiography revealed no fixed stenosis in the artery. We have to recognize the types, clinical features and functional properties of the coronary artery anomalies for preventing misdiagnosis of coronary angiogram and deciding the best treatment for patients.>

Introduction

"Dual left anterior descending artery (LAD)" is a rare anomaly of the LAD. The variant consists of two branches bifurcating at the proximal portion of the LAD, which are described as "the short LAD" and "the long LAD," respectively. The former is defined as the vessel that runs in the proximal anterior interventricular sulcus (AIVS) and terminates along the way in the AIVS, while the latter deviates from the proximal AIVS and reenters the middle AIVS for apex. In 1983, Spindola-Franco et al. classified the variant into four categories (type I–IV) according to origins, courses, and distributions of the anomalous vessel [1]. In the type IV dual LAD, the long LAD is exceptionally arising from the right coronary artery (RCA). We present a case of type IV dual LAD with chronic total occlusion (CTO) of the RCA. In this case, we needed to evaluate the area of myocardial ischemia carefully and to decide the optimal treatment for the patient because of the critical running course of the long LAD between aortic root and right ventricular outflow tract (RVOT).

Case report

A 65-year-old male patient was referred to our hospital because of the abnormal electrocardiogram of a complete right bundle branch block (CRBBB). He did not present any symptoms including exertional chest discomfort, dyspnea, and syncope even when he was working as a carpenter. He had a history of heavy smoking (30 cigarettes per day, 45 years) and hypertension well treated with an oral calcium channel blocker. Physical examination revealed no heart murmur or chest rales. Laboratory findings showed slight high blood concentrations of low-density lipoprotein cholesterol (145 mg/dl), triglyceride (189 mg/dl), and B-type natriuretic peptide (29.9 pg/ml), whereas the levels of troponin T, creatinine

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kinase, fasting blood glucose, and renal function were all normal. The 12-lead electrocardiogram showed normal sinus rhythm (68 beats per minute) with a CRBBB and abnormal Q waves in inferior leads. Echocardiography revealed the hypokinesis of inferior wall of the left ventricle (ejection fraction was 49%) and no significant valvular or congenital heart diseases. On the basis of these findings, the patient was suspected of having ischemic heart disease and cardiac catheterization was performed to examine the presence of coronary atherosclerotic lesions.

Left coronary angiography revealed that the LAD arising from left main coronary trunk (LMT) had an abrupt termination at the proximal portion of segment 6 after branching into small left ventricular diagonal branches. The left circumflex artery (LCx) was also arising from the LMT and coursing along the left atrioventricular groove without clinically significant stenosis (Fig. 1a and b). Right coronary angiography showed that the RCA had CTO at segment 2 and that the territory of distal RCA was perfused by collateral blood flow of Cohen–Rentrop grade 2 from the right ventricular branch and grade 3 from the left obtuse marginal branch. Additionally, the unique vessel that diverged from the proximal portion of RCA was getting across the aortic root toward the left sinus of Valsalva and coursing to a parallel direction with AIVS from base to left ventricular apex without organic stenosis (Fig. 1c and d). The ostium of the RCA and LMT was at the normal site easily engaged using Judkins' catheters (4 Fr JR 4 and JL 4) in the right and left sinus of Valsalva, respectively. At first glance, we made a diagnosis of CTO of RCA and LAD. However, we noticed strange septal branches separated from the transverse portion of the vessel outside the AIVS (Fig. 1c, white asterisk) after cardiac catheterization. Thus we came to understand the possibility that the patient has an anomalous LAD but not CTO of the LAD.

Three hundred and twenty-row area detector computed tomography (ADCT) was performed to examine the structural aspects of his coronary arteries, indicating the clinically critical course of anomalous LAD between aortic root and RVOT (Fig. 2). Therefore, we decided to perform technetium myocardial perfusion scintigram as a further examination to detect exercise-induced ischemia in the territory of anomalous LAD. During exercise no symptoms including chest pain or shortness of breath, nor morphological change of the electrocardiogram were seen. The results revealed no apparent evidence for ischemia in the area perfused by anomalous LAD despite adequate exercise stress and a constant perfusion defect in the territory of the RCA (Fig. 3). Consequently, we decided to treat the patient with the medication of aspirin, calcium channel

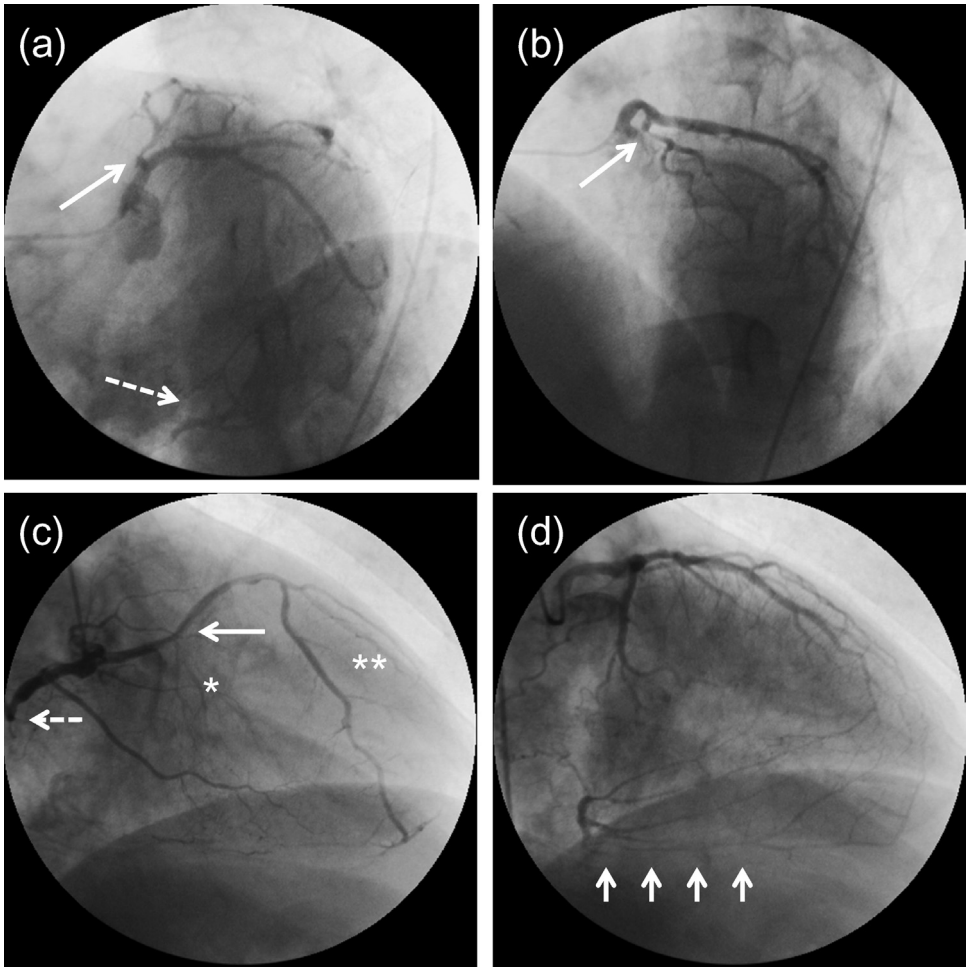

Fig. 1. Coronary angiograms. (a and b) Left coronary angiography showed the termination of the left anterior descending artery at segment 6 just after branching into left ventricular 1st diagonal branches (white solid arrow). The left circumflex artery (LCx) provided collateral blood flow to the distal right coronary artery (RCA) (white dotted arrow). (a) Left anterior oblique caudal (spider) view. (b) Left anterior oblique cranial view. (c) Right coronary angiography (right anterior oblique view) showed chronic total occlusion at segment 2 (white dotted arrow) and the transverse vessel separated from the RCA (white solid arrow) branching into 1st septal branches at the transverse portion (white asterisk) and 2nd left ventricular diagonal branches (white double asterisk). The vessel was coursing toward the left ventricular anterior wall and supplying a few branches to the territory of the RCA. (d) Left coronary angiography (right anterior oblique view) showed good collateral blood flow (white solid arrows) from obtuse marginal branch and the distal LCx to the RCA.

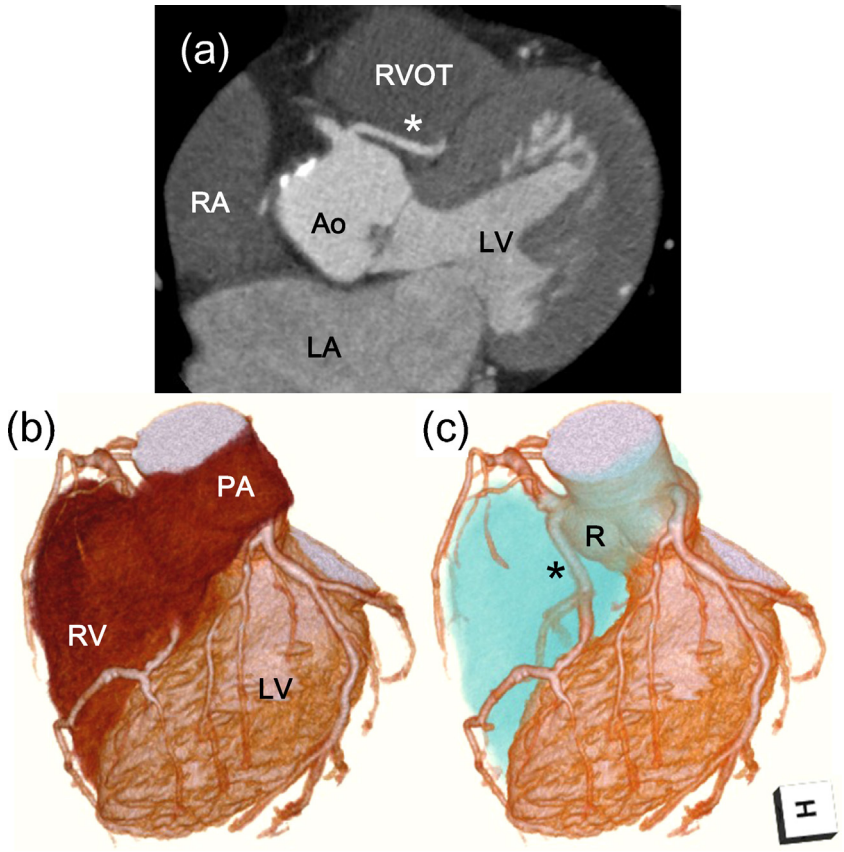

Fig. 2. 320-Row area detector computed tomography (ADCT). (a) 320-Row ADCT revealed the anomalous left anterior descending artery (LAD) (the long LAD) separated from right coronary artery with sharp turn toward anterior interventricular sulcus, which was coursing between aortic root and RVOT (white asterisk). (b) The spatial relationship between ventricular chambers and great vessels was visualized by three-dimensional volume rendering technique (left anterior oblique cranial view). The long LAD did not cross in front of RV. (c) Three-dimensional volume rendering revealed an overview of the coronary arteries. Lucent blue area indicates RV and pulmonary artery. The long LAD was coursing between aortic root (right sinus of Valsalva) and RVOT (black asterisk). Ao, aortic root; LV, left ventricle; LA, left atrium; RVOT, right ventricular outflow tract; RA, right atrium; PA, pulmonary artery; R, right sinus of Valsalva.

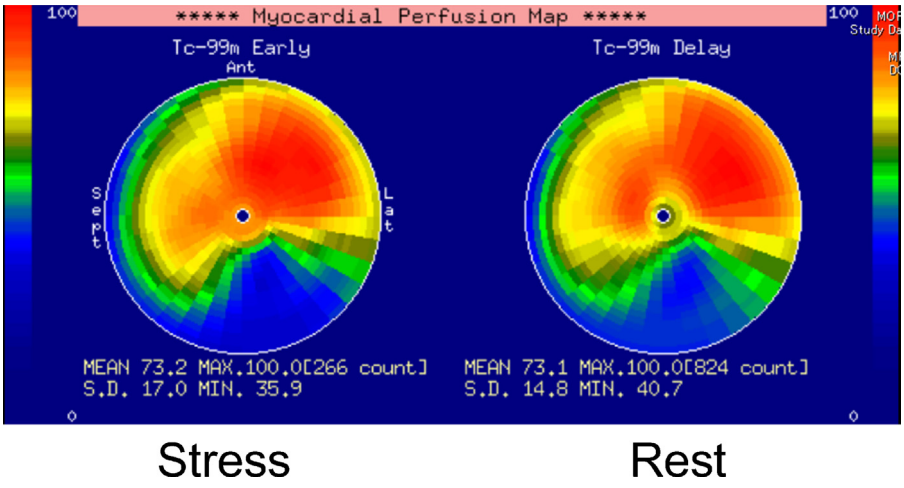

Fig. 3. Technetium myocardial perfusion scintigram. Perfusion imaging revealed no exercise-induced ischemia in anteroseptal and a constant perfusion defect in posteroinferior of the left ventricle.

blocker, and statin. The patient was discharged and now returns for follow-up visits to our hospital regularly without any cardiac event.

Discussion

The anatomy of coronary arteries is usually discussed in terms of the location of the ostium, the course of coronary arteries, and their sites of termination [2,3]. There are many variants of coronary arteries such as the dominant RCA or LCx and the split origin of LAD and LCx from left sinus of Valsalva observed in coronary angiography, however it is sometimes difficult to be aware of the existence and to understand the clinical features of rare coronary artery anomalies including single coronary artery, ectopic origins of coronary arteries from the opposite sinus of Valsalva or the pulmonary trunk [4–6]. In 1990, Yamanaka et al. reported that 1.3% of

patients undergoing coronary angiography had isolated congenital coronary artery anomalies [7]. Coronary artery anomalies are usually asymptomatic at rest and detected incidentally by coronary angiography, however exercise-induced chest pain is sometimes caused in some patients with these anomalies. These anomalies are also found in autopsies of hearts of competitive athletes or children and adolescents undergoing sudden death, which implies clinical importance [8,9].

Isolated LAD anomalies including dual LAD have definite origin and course. Spindola-Franco et al. classified dual LAD into four subtypes (type I–IV) on the basis of coronary angiographic findings in 1983 [1]. The anomaly consists of two branches bifurcating at proximal portion of the LAD, which are described as "the short LAD" and "the long LAD". In type I–III, the short LAD arising from LMT divides into the proximal major septal branch and the blind end of short LAD in the proximal AIVS. The long LAD separated from the short LAD descends on the left ventricular side of the AIVS in type I, the right ventricular side of the AIVS in type II, and into ventricular septum in type III. In type IV, the long LAD exceptionally arises from the proximal RCA and runs toward the middle AIVS. Type IV dual LAD from the proximal RCA is extremely rare, and was found in only 1.8% patients with congenital coronary artery anomalies [10]. According to previous reports, the course of the long LAD of type IV dual LAD was identified at the anterior site of RVOT or posterior retro-aortic site by use of coronary angiogram and coronary CT scan [11].

Our case was categorized as type IV dual LAD and considered unique as the long LAD was coursing between the aortic root and RVOT. If the exercise-induced ischemia is provoked in the territory of the long LAD, coronary artery bypass grafting surgery (CABG) is usually performed for coronary revascularization because the mechanism of cardiac ischemia is the compression of the anomalous long LAD from the aortic root and RVOT during exercise [12–14]. Therefore, this course of the anomalous vessel is more significant in clinical practice than those of anterior RVOT or posterior aortic root. Moreover, CTO of the RCA was associated with the anomaly. If the myocardial viability of the territory of RCA exists, percutaneous coronary intervention (PCI) is probably effective for coronary revascularization. Thus, we had to carefully evaluate the lesion of ischemia and the indication for coronary revascularization including PCI and CABG to the anomalous long LAD in our case.

As a result, the territory of the long LAD was not exposed to the risk of exercise-induced ischemia according to the scintigram. In addition, the revascularization to CTO of RCA was not necessary because of the loss of myocardial viability in the area.

Recently, cardiac catheterization has been easily performed to make a diagnosis for ischemic heart disease, while the anomalies of coronary artery are rare entities. So we have to recognize the possibility of the coronary artery anomalies such as dual LAD for preventing misdiagnosis of coronary angiogram and subsequently performed revascularization. In this case, multidimensional evaluation using 320-row ADCT and exercise stress myocardial scintigraphy were instructive to understand the clinical properties of type IV dual LAD with CTO of the RCA and to determine the optimal treatment for the patient.

Conflict of interest

Authors declare no conflict of interest.

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